Thoracic Cirripedia from a Southeast Pacific Guyot

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A DREDGE HAUL taken at a depth of 228 m from a flat-topped seamount (guyot) by the "R/V Horizon" in January 1958, during the Scripps Institution of Oceanography IGY cruise to the southeast Pacific, has yielded specimens of four genera of barnacles representing three extant suborders of the order Thoracica. The Lepadomorpha are represented by a new species of *Megalasma s. str.* Hoek (1883) and by a new species of *Heteralepas s. str.* Pilsbry (1907). The Verrucomorpha are represented by a new species of *Verruca* Schumacher (1817), and the Balanomorpha by a new species of the subgenus *Solidobalanus* Hoek (1913) of the genus *Balanus* Da Costa (1778).

Neither *Megalasma* nor *Solidobalanus* has been previously reported from the eastern Pacific. The former is but the second member of the family Poecilasmatidae known from this zoogeographic province. *Heteralepas* has been recorded twice from the eastern Pacific: *Heteralepas quadrata* (Aurivillius, 1894) from Lower California, and *H. cygnus* Pilsbry, 1907, presumably from Monterey, California. No other reports on members of the entire family Heteralepadidae in the eastern Pacific have been made since, although one of us (W.A.N.) has recently examined specimens referable to *H. quadrata,* occurring on *Panulirus penicillatus* (Oliver) from the Galapagos Islands.

Verruca had previously been known from the west coast of South America by the extant littoral species *V. laevigata* Sowerby (Darwin, 1854:520), and from the Pliocene in the vicinity of Nome, Alaska, by the presumed littoral species *V. alaskana* Pilsbry (MacNeil et al., 1943: 95). In addition to the published fossil record of *Verruca* in the eastern Pacific, several isolated compartmental plates of a new species of this genus from the Oligocene Gries Ranch beds of Washington are contained in the Museum of Paleontology of the University of California, Berkeley (hereafter referred to by the abbreviation UCMP).

The unnamed guyot from which the present sample was taken is located on the southwest end of Nasca Ridge (Fig. 1) at 85° 25′ W, 25° 44′ S, about 1280 km (800 miles) off the coast of Chile and 480 km (300 miles) approximately N 80° W of San Felix Island (Fisher, 1958, fig. 8, station HD-73). A triglid fish has been described from the same sample (Hubbs, 1959:313–315), and a manuscript on a new species of the stirodont echinoid *Salenia* Gray is in press (Zullo, Kaar, Durham, and Allison).

We wish to extend our thanks to Mr. Robert H. Parker of the Scripps Institution of Oceanography for making available the material described in this paper. The descriptions and figures of the new species of *Megalasma* and *Heteralepas* were prepared by W. A. Newman. The new species of *Verruca* and *Balanus* were described by V. A. Zullo and illustrated by Ruth L. von Arx.

SUBORDER LEPADOMORPHA Pilsbry

FAMILY *POECILASMATIDAE* Annandale

Synonymy: Nilsson-Cantell, 1921; Trilasmatidae Nilsson-Cantell, 1934*a*.

GENUS *Megalasma* Hoek

Megalasma (*Megalasma*) *elegans* Newman, sp. nov.

Figs. 2*A–I*

DIAGNOSIS: Capitulum of five completely calcified, fully approximate valves; carina with internal transverse plate forming a single internal

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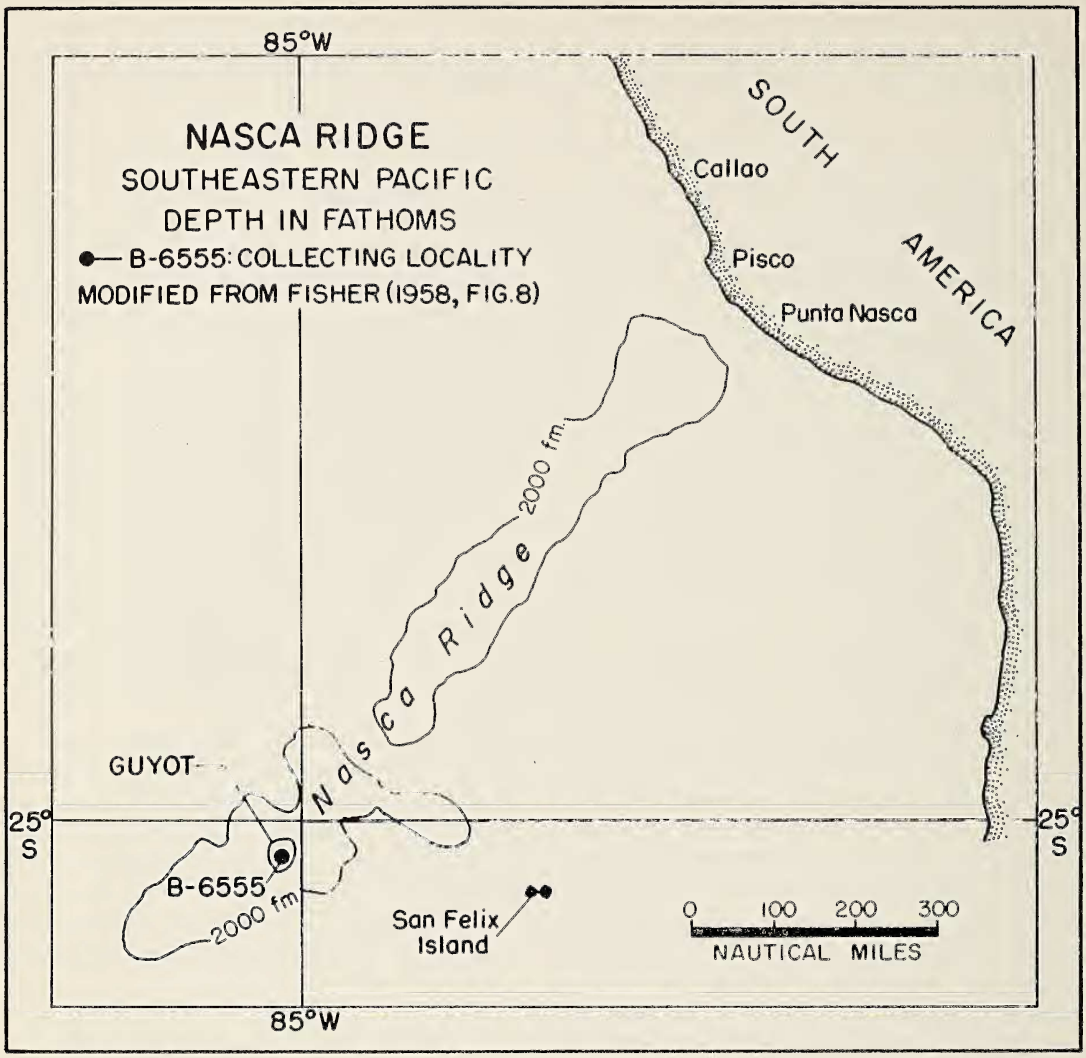


FIG. 1. Map showing location of UCMP locality B-6555.

tooth on either side; occludent margin of tergum nearly one-third length of occludent margin of scutum; portion of scutum below umbo rotated approximately 90°, forming continuation of occludent margin below scutal umbo; outer surface of basal portion of carina marked by approximately six rows of low, weak ridges; strong beaded ridge seen in *M.* (*M.*) *striatum* Hoek, running in arc from below the scutal umbones across the basal portion of the scuta and carina to the carinal umbo, lacking.

Prosoma strongly developed; insertion of cirrus I widely separated from that of cirrus II, on posteroventral margin of prosoma; single pair of dorsal thoracic filamentary appendages situated approximately halfway between the insertions of cirri I and II; cirri long, ctenopod; five pairs of setae on intermediate articles of posterior cirri, major pairs pinnate; outer surface of pedicles of all cirri marked by finely spaced lines or broad scales; major spines of caudal appendage plumose.

DESCRIPTION: Terga (Figs. 2*A, B, C*–1) triangular, occludent margins approximately one-third, and scutal margins nearly two-thirds length of scuta; outer surface nearly flat, lightly marked by transverse growth lines and minute longitudinal ridges; terga form a flat continua-

tion of the carinal margin and are marked by chevron-shaped growth lines; primordial valves apical; interior moderately concave, smooth; scuto-occludent angle with fossa to receive projection formed by tergo-occludent angle of scutum.

Scuta (Figs. 2*A, B, C*–2) broadly triangular, divided into two portions by a ridge running from the umbones to the tergolateral angles; exterior marked by distinct growth lines running transversely above, and nearly longitudinally below the dividing ridge; minute ridges running perpendicular or nearly perpendicular to them; surface above dividing ridge broadly convex; below ridge, reflexed outwards laterally to form, with its neighbor and the expanded basal portion of the carina, a receptacle for the peduncle; interior smooth, broadly concave; elevated occludent margin terminating in a smooth articular surface at the umbo; portion basal to umbo forming ventrolateral elements of peduncular receptacle; carinal margin supporting shallow fossa in lower third, receiving lateral tooth of carina; umbo situated approximately one-fifth the length of the occludent margin of the scutum from the base; faint scar of the strong scutal adductor muscle located just inside the ridge of the occludent margin opposite the tergolateral angle.

Carina (Figs. 2*A, B, C*–3, *D*) indistinctly divided into two regions due to expansion and flection of basal portions in forming the carinolateral elements of the peduncular receptacle; external surface of basolateral portions supporting about six rows of short, small, weak ridges; entire valve crossed by longitudinal growth lines running nearly parallel to the scutal margin; carinal margin with chevron-shaped growth lines running into a shallow V-shaped trough or depression; this depression not continued forward onto the carinal ridge formed by the carinal margins of the terga; primordial valve occasionally supported on a projecting umbonal portion (cf Figs. 2*B, D*); this arrangement apparently not correlated with size in the dozen specimens examined, as suggested by Barnard (1924); inner cup-shaped plate, along with expanded lateral portions, forming carinal contribution to the peduncular receptacle, produced laterally as a pair of teeth; distal angles flared laterally, forming articular surfaces on which the terga and scuta bear; capitulum of holotype UCMP 37860, the largest specimen, measured 9.5 mm high, 3.8 mm deep, and 3.6 mm wide; peduncle had average diameter of 1.2 mm and extended 0.82 mm below basal margin of carina; orange ovigerous lamellae visible through semitranslucent shell; smallest specimen in series 3 mm high.

Labrum (Fig. 2*E*) produced anteriorly in a V-shaped trough, divided into right and left portions by a medial ridge in the chitin; supporting 22–24 small, stout, sharp teeth; mandibular palps spatulate, attached to labrum; superior margin slightly concave, supporting numerous spines along superior and inner margins (left palp in Fig. 2*E* aberrant); mandible (Fig. 2*F*) remarkably long, with four teeth, not including inferior angle; inferior angle bifid; surface clothed with short spinules, a few of which extend over cutting edge; superior and inferior margins and notch between first and second teeth supporting long spines; inner maxilla (Fig. 2*G*) with three major spines above and many below notch; notch, and superior and inferior margins, supporting several spines; surface clothed sparsely with degenerate spinules occurring in groups of one to four; outer maxilla (not figured) nearly one-third again as long as high; superior margin slightly concave; superior and inner margins supporting long, relatively heavy setae or spines.

Cirrus I widely separated from II; attached to posteroventral margin of prosoma; rami subequal; outer ramus approximately twice as wide as inner ramus, setae arranged nearly symmetrically on both lesser and greater curvatures; terminal article supporting about six strong spines; inner ramus densely setose on lesser curvature, a few spines at each articulation on greater curvature, articles slightly longer than wide; setal arrangement essentially ctenopod and normal in appearance; remaining cirri clearly ctenopod; each cirrus in turn longer than the preceding; rami subequal; proximal articles (except the first) nearly as long as wide; intermediate articles nearly 4 times as long as wide, each with five pairs of setae, the two or three stronger pairs pinnate; first proximal article long, apparently composed of several fused segments; pedicles of all cirri supporting a single row of minute spines along posterior margins

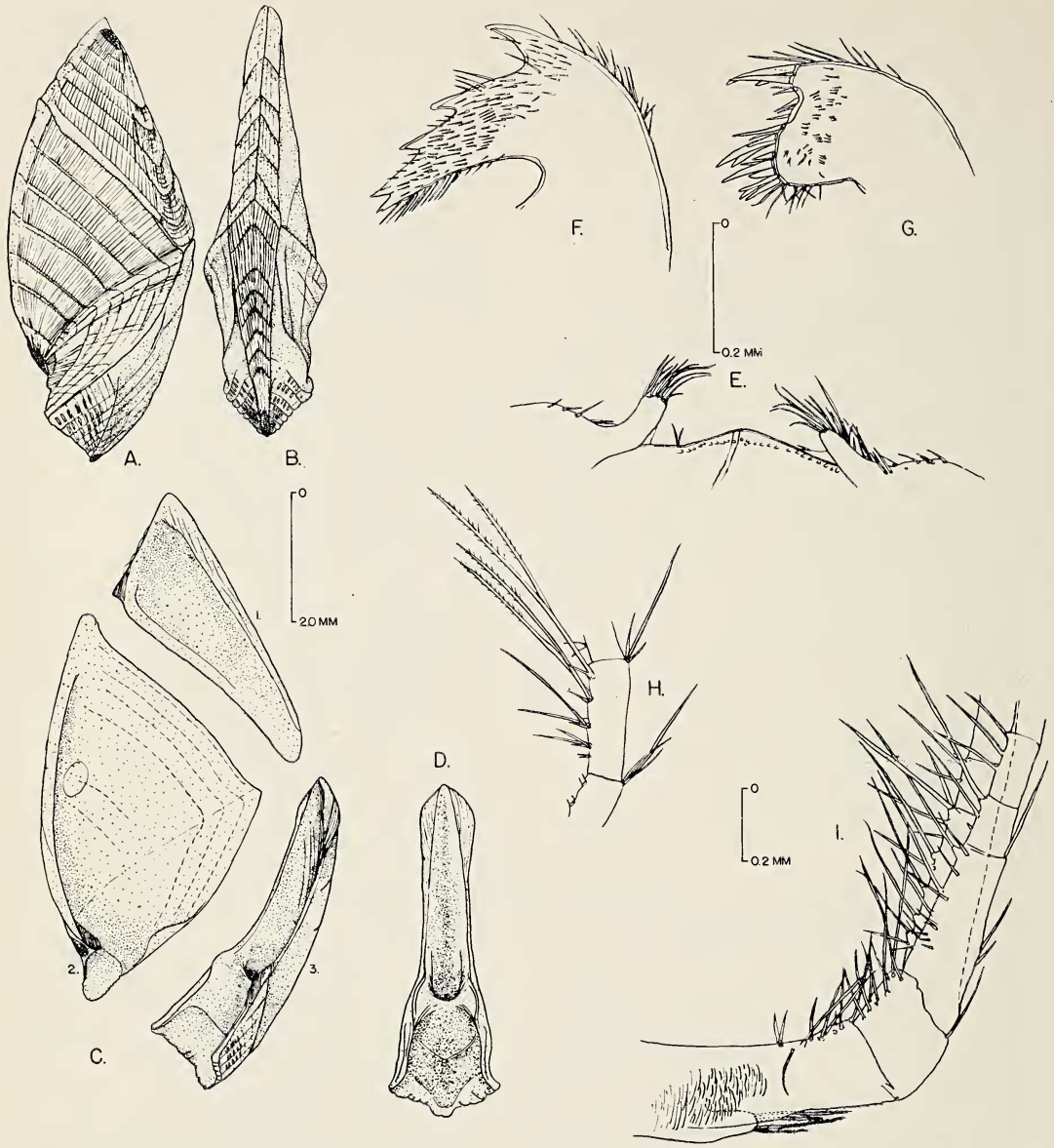


FIG. 2. *Megalasma* (*Megalasma*) *elegans* Newman, sp. nov. Figs. *A, B, E–I,* Holotype UCMP 37860 (peduncle not figured). Figs. *C, D,* Interior aspect of disarticulated valves of a paratype. Fig. *C–1,* Tergum. Fig. *C–2,* Scutum. Fig. *C–3,* Carina. Fig. *D,* Carina. Fig. *E,* Labrum and palps (left palp aberrant). Fig. *F,* Mandible. Fig. *G,* First maxilla. Fig. *H,* Eighth article of outer ramus of cirrus VI. Fig. *I,* Pedicle and proximal articles of cirrus VI, and caudal appendage. (Figs. *A–D* same scale, *E–G* same scale, *H, I* same scale.)

and fine closely spaced scales on raised posterolateral surfaces; despite the long, delicate and ctenopod nature of the cirri, apparently adapted to capture small particles or prey, the rami are made up of relatively few articles; counts for a single ovigerous specimen (holotype UCMP 37860) given below:

Cirrus:	I	II	III	IV	V	VI
Outer ramus:	10	13	16	16	17	14
Inner ramus:	10	12	15	18	16	14

Caudal appendage (Fig. 2*I*) short, supporting approximately four plumose spines and occasionally one or two small spinules. Penis (not figured) relatively small, slender and in-

conspicuous; surface clothed sparsely throughout with long, soft setae and an occasional short spine; distal end supporting numerous long, soft setae which obscure details of apex; surface irregular and lumpy, no annulations observable.

TYPE DESIGNATION: Holotype: UCMP 37860. Paratypes: UCMP 37861, 37862. Additional specimen: U.S. National Museum, Washington D.C., no. 109781.

DISCUSSION: The status and definition of the genus *Megalasma,* especially of the less clearly defined subgenus *Megalasma* (*Glyptelasma*), has been discussed and emended by a number of authors, particularly Calman (1918, 1919). Krüger (1940:29, table 1) indicates that at least five species of the subgenus *Megalasma* (*Megalasma*) have been described. These can be divided into two series: *"Striatum,"* the type species of the genus and subgenus, and *"Minus,"* the second form of the subgenus to be described. The latter series may contain as many as three species. However, the views of Barnard (1924), Nilsson-Cantell (1938), and Utinomi (1958), when taken together, suggest that there is only one species contained in the *Minus* complex. The inclusion of *M. striatum* in a portion of the *M. minus* synonymy by Weltner (1922) is apparently by *lapsus calami.* The present report is not directly concerned with the *"Minus"* synonymy, having no additional data, and simply follows the synonymy proposed by these workers:

1. *Megalasma* (*Megalasma*) *striatum* Hoek, 1883
2. *Megalasma* (*Megalasma*) *minus* Annandale, 1906*b*
   Megalasma striatum minus Annandale, 1906*b*
   Megalasma lineatum Hoek, 1907
   ?Megalasma bellum (Pilsbry, 1907*c*)
   ?Megalasma carinodentatum Weltner, 1894

The two series are closely related, differing in proportions and details of the articulations of the valves. Following the views of Pilsbry (1907*c*) and Broch (1922), the degree and specialization in armament seen in *Megalasma s. str.* has progressed, from *Poecilasma* through *Glyptelasma.* The most highly developed form is *Megalasma striatum,* in which the terga are enlarged (a condition that reduces the relative height of the carina to half the height of the entire capitulum) and the lateral margins of the distal portions of the carina are strongly developed articular surfaces. It is to the *striatum* section of the subgenus that the new species described here belongs.

Megalasma (*Megalasma*) *striatum* is very similar to the form described here. The lateral view of *M.* (*M.*) *striatum* depicted by Hoek (1883, pl. 2, fig. 5) and Broch (1922, text fig. 29) shows a ridge of coarse beads or elevations running in an arc across the basal portion of the scutum from the umbo to the lateral margin. The arc then continues to the basal portion of the carina and terminates at its umbo. The dorsal aspect given by Hoek (loc. cit., pl. 2, fig. 6) does not show the course of this beaded ridge on the carina as one would expect, but only a peculiar elevation formed along the lateral margin of the scutum. At first inspection it would appear that Gruvel (1905, text fig. 126) had merely traced Hoek's drawings; however, the dorsal aspect of the basal portion of the carina is considerably different than that illustrated by Hoek. It shows clearly the course of the beaded ridge extending outwardly from the carinal umbo. The form described here clearly lacks this ridge as viewed from both lateral and dorsal aspects. The basal portion of the scutum (Fig. 2*A*) is essentially smooth, unmarked by beads or ridges. The basal portion of the carina (Figs. 2*A*, *B*) also lacks the ridge seen in *M.* (*M.*) *striatum* figured by Hoek, Gruvel, and Broch, but below this area there are approximately 6 rows, each of 2–10 short ridges, running to the basal margin.

Of the trophi only minor differences were found. The lower angle of the mandible, including the fourth tooth (Fig. 2*F*), is much more strongly produced than that figured by Hoek (loc. cit., pl. 1, fig. 8) and by Utinomi (loc. cit., text fig. 4b) for *Megalasma* (*Megalasma*) *striatum.* The notch of the first maxilla (Fig. 2*G*) is less pronounced and the setae clothing its surface are short and weak, appearing vestigial. The second maxilla is longer than high, probably corresponding to the proportionately greater length of the mandible.

The ctenopod chaetotaxis (Fig. 2*H*) appears the same as that of *Megalasma* (*Megalasma*) *striatum.* However, in the new species the major

setae are pinnate. In a figure titled "Caudal Appendage" drawn by Utinomi (loc. cit., text fig. 4E), a portion of the first article of the peduncle of the sixth cirrus is illustrated. Utinomi figures two rows of conspicuous small, stout barbs (it is possible that the two-row effect is produced by an approaching molt), and a major simple spine of the caudal appendage. The present species has but a single inconspicuous row of smaller, less numerous barbs and these occur on the pedicles of all cirri. The major spines of the caudal appendage are densely and conspicuously plumose, an unusual feature, one apparently lacking in *M. striatum*. Finally, the outer surface of the pedicles of all cirri are transversely marked by fine, closely spaced lines.

Megalasma (*Megalasma*) *striatum* is reported from the spines of sea urchins from deep waters of the Indo-Pacific and Japan, while the species described here is so far known only from gorgonacean skeletons in the eastern Pacific, nearly 9000 miles from the known range of *M.* (*M.*) *striatum*.

FAMILY HETERALEPADIDAE Nilsson-Cantell

Synonymy: Nilsson-Cantell, 1921.

GENUS *Heteralepas* Pilsbry

Heteralepas mystacophora Newman, sp. nov.

Figs. 3*A–H*

DIAGNOSIS: Capitulum ovoid, slightly compressed, lacking valves; cuticle smooth, with or without indistinct carinal ridge; orifice one-fourth length of capitulum; lips protuberant, margins crenulate; position of scuta marked by slightly elevated oval thickenings below and to either side of the orifice; peduncle approximately one-half length of and distinct from capitulum; cuticle smooth, marked by fine lines; peduncle expanded into attachment disc; labrum slightly bullate, bearing a remarkable growth of fine, soft setae; crest toothed; lateral portions squamous; mandible with four teeth, including inferior angle; superior margins of second and third teeth supporting several widely spaced spinules; first maxilla with three major spines above and approximately seven major spines below notch; lower margin of cutting edge equal to half the length of the entire cutting edge; second maxilla broadly rounded, spines lacking along median portion of inner margin; inner rami of cirri V and VI atrophied; penis with long setae and short, sharp spines scattered over surface, inconspicuously annulated, without minute, specialized, rivet-like structures.

DESCRIPTION: Capitulum (Figs. 3*A, B*) ovoid in lateral aspect, carinal margin broadly convex; convex curvature of occludent margin interrupted by protuberant lips of orifice; carinal ridge, when present, indistinct (the animals were received dry and one cannot tell how much the effect of drying is responsible for the condition of the indistinct carinal ridge); no other prominent distinguishing warts, bumps or protuberances were observed other than an inconspicuous but definite thickening, a little less than one-half the distance up the carinal margin of the capitulum. This thickening is rather peculiar. In two specimens (including the holotype) a small tear or perforation, communicating with the mantle cavity, was evident at the upper end, and in one specimen the cirri protruded through to the outside. U-shaped orifice relatively small, approximately one-fourth the height of the capitulum; slightly crenulate lips continuous above but not below; mantle wall thin, cuticle smooth, except where marked by fine lines and minute folds about the orifice and at the capitulo-peduncular junction. Dried specimens were an opaque, reddish-brown color. Peduncle essentially one-half length of capitulum, about as long as wide, marked by several folds and by fine lines in the otherwise smooth cuticle; basal portion of peduncle expanded into attachment disc; holotype UCMP 37863 (Figs. 3*A, B*) measured:

	Capitulum	*Peduncle*
Length:	1.6 mm	0.85 mm
Width:	1.4 mm	0.85 mm
Depth:	1.6 mm	—

Labrum (Fig. 3*C*) slightly bullate, anterior portion covered with numerous long, fine, soft setae; crest supporting 12–14 equally spaced, small, sharp teeth; sides of labrum, posterior to insertion of palps, finely squamous. Palp (Fig. 3*C*) nearly triangular, superior margin supporting several long spines, outer surface sparsely scaled. Mandible (Fig. 3*D*) with five teeth

FIG. 3. *Heteralepas mystacophora* Newman, sp. nov. Figs. *A, B,* Holotype UCMP 37863. Fig. *C,* Labrum and palps. Fig. *D,* Mandible. Fig. *E,* First maxilla. Fig. *F,* Second maxilla. Fig. *G,* Intermediate articles of outer ramus of cirrus V. Fig. *H,* Distal quarter of penis. (Figs. *A, B* same scale, *D–H* same scale.)

including inferior angle; upper surface of second and third teeth supporting a few widely spaced spinules; fourth tooth with a few small accessory spines near base; superior margin of mandible with row of numerous paired setae; inferior margin supporting approximately eight spines; a group of several spines near superior angle, and a lower group of numerous short spines in groups or singly similar in arrangement to that seen in *Heteralepas gigas* (Annandale, 1905, pl. 8, fig. 3b). First maxilla (Fig. 3*E*) with three major spines above and approximately seven major spines below prominent notch; a few long spines in a group along superior margin, and two long spines near the base of first major spine; cutting edge composed of notch and superior spines equal in length to cutting edge below notch; surface clothed with numerous slender spinules arranged in groups and rows; notch supporting a few strong spines; inferior margin with approximately eight long spines. Second maxilla (Fig. 3*F*) broadly rounded; superior margin with minute and widely spaced serrations and a few spines; inner margin supporting long plumose spines in two groups, one at the superior and the other at the inferior angle; space between these two groups without spines (a condition occasionally seen in *Heteralepas japonica* according to Nilsson-Cantell, 1927). At least two very long pinnate spines on swelling at proximal portion of inferior margin.

Insertion of cirrus I widely separated from cirrus II, attached to posterior margin of prosoma; cirrus I approximately one-half length of cirrus II, supporting a single posteriorly directed ensiform filamentary appendage at its base; cirri II–VI essentially equal in length; inner ramus of cirri V and VI atrophied; pedicles of all cirri faintly squamous; long setae of all cirri finely pinnate, but becoming progressively less so posteriorly; inner ramus of cirrus I somewhat shorter than the outer, and more heavily clothed with setae; rami equal in width, arrangement of setae lasiopod (as many as 12 long, strong setae in staggered transverse whorl), with at least one major spine at each articulation along the greater curvature on intermediate articles; outer ramus of cirrus II slightly longer than the inner, setae arranged normally (cf Fig. 3*G*); setal arrangement of inner ramus intermediate between normal form and that of outer ramus of cirrus I; inner rami of cirri V and VI atrophied, approximately one-fifth length of outer rami; proximal articles of all cirri tending to fuse; unfused proximal articles two-thirds wider than long, intermediate articles as wide as long, distal articles essentially one-half as wide as long; counts for cirri of the holotype UCMP 37863 and a paratype (in parentheses) are given below. Unfortunately, the tips of many rami had been nipped off and no count could be made.

Caudal appendages of five articles nearly as long as the first article of the pedicle of cirrus VI, last two articles supporting a few long spinules, apex with a tuft of several short and two long spinules. Penis (Fig. 3*H*) weakly annulated, relatively short, slender, tapering gradually throughout its length; clothed with numerous long, soft setae and occasional short spines; apex truncate, supporting a tuft of short stiff bristles.

TYPE DESIGNATION: Holotype: UCMP 37863. Paratype: UCMP 37864. Additional specimen: U.S. National Museum, Washington, D.C., no. 109782.

DISCUSSION: Although the species described here cannot be assigned to any of the known forms of *Heteralepas s. str.,* it is similar to several, some of which are of uncertain status. These are:

1. *Heteralepas japonica* (Aurivillius, 1894)
2. *H. indica* (Gruvel, 1902)
3. *H. gigas* (Annandale, 1905)
4. *H. cygnus* Pilsbry, 1907
5. *H. lankesteri* (Gruvel, 1901)
6. *H. quadrata* (Aurivillius, 1894)

Except for *H. quadrata,* these forms generally occur on the spines of sea urchins. They are characterized externally by an ovoid, slightly compressed, relatively smooth capitulum, and protuberant or slightly protuberant lips. Except

Cirrus:	I	II	III	IV	V	VI	C.A.
Right outer ramus:	16(19)	–(37)	–(42)	–(41)	–(–)	35(–)	–(5)
Right inner ramus:	10(13)	29(27)	–(–)	–(39)	6(11)	8(8)	
Left outer ramus:	16(19)	31(39)	–(–)	–(40)	–(45)	–(–)	5(–)
Left inner ramus:	11(13)	25(31)	–(–)	–(–)	10(10)	–(11)	

for *H. lankesteri* from the West Indies, they are reported from the Pacific and Indian oceans.

Nilsson-Cantell (1927) discusses variability in certain external and internal characteristics ordinarily utilized in distinguishing members of the genus. In an extensive study of *H. japonica,* he concluded that *H. indica* is but a form of this species and that the status of *H. nicobarcia* Annandale, *H. gigas,* and *H. cygnus* is subject to re-examination in the light of his findings. Broch (1931), Nilsson-Cantell (1938), and Utinomi (1958) list *H. indica* as a synonym of *H. japonica,* but the status of the other species has not been altered. Whatever the status of these species, the form described here differs from them in a number of ways, in that *H. japonica* and its allies have a rather large orifice, occupying essentially one-half the occludent margin of the capitulum, and the mandible, at least of *H. japonica,* has pectinations on the underside of the first, second, and third teeth. The orifice of *H. lankesteri* is a little less than one-half the height of the capitulum, but the mandible is essentially that of *H. japonica.* Remaining then is *H. quadrata.* It generally occurs on *Pavulirus* in the Pacific. Despite its similar appearance, it can be separated from the species described here by the presence of minute rivet-like structures (figured by Utinomi, 1949) on the penis.

The nearly naked Lepadomorpha present a difficult problem for the systematist since, being unarmored, they lack a number of distinctive features customarily utilized in separating genera and species. Turning to a comparative study of the appendages, Pilsbry (1907) was able to separate *Heteralepas s. l.* from *Alepas,* and to split the genus into two distinct subgenera: *Heteralepas s. str.* and *Paralepas.* However, he retained the heterogeneous assemblage Alepadinae. Nilsson-Cantell (1921) furthered our understanding of this group by placing *Heteralepas s. l.* in a separate subfamily, the Heteralepadidae. Further work sustained Pilsbry's subgeneric distinctions, and, as a consequence of his suggestion, the subgenera were finally recognized as separate genera (Newman, 1960).

At higher taxonomic levels the group would appear to be in fairly good order. However, as has been discussed above, this is not true as far as many of the species are concerned. In fact, it seems fair to say that we simply do not know what morphological and zoogeographic data are really applicable in making judgments at the specific level, there being so little information to go on. Aside from the work of Nilsson-Cantell (1927), no critical studies have been made. Thus it is difficult to establish a new form with any degree of certainty, for extensive collections would be required and they are simply not available. Therefore much of the time spent in study of this form was devoted to comparing characters with the known range of variability. Even so, with the extreme latitude allowed by synonymy, the present form could not be assigned to any known species.

The new species has been named *H. mystacophora* ("mustache bearer") for the numerous soft setae clothing the bullate portion of the labrum or upper lip. This condition is indeed unusual, and it is difficult to conceive what function it may serve. Yet the palps are provided with long setae or spines, perhaps stronger and certainly fewer than is usual in cirripeds, and they are in a position to be drawn through the labral setae. Perhaps in this way material entangled there could be brought to the mouth field.

SUBORDER VERRUCOMORPHA Pilsbry

FAMILY VERRUCIDAE Darwin

GENUS *Verruca* Schumacher, 1817

SUBGENUS *Verruca s. str.*

Verruca Schumacher, Pilsbry, 1916, U.S. Nat. Mus. Bull. 93, p. 23.

Eu-Verruca Broch, 1931, Vidensk. Meddel. Dansk naturhist. Foren., Bd. 91, p. 45.

Verruca (*Verruca*) *scrippsae* Zullo, sp. nov.

Figs. 4*A–K*

Dimensions of holotype UCMP 34713: height of shell, 2.5 mm; carinorostral diameter of base, 6 mm; lateral diameter of base, 4 mm; carinorostral diameter of orifice, 2.5 mm.

Shell (Figs. 4*A, B*) depressed, boxlike, colored white in dried specimen with adherent particles of yellow-brown epidermis; fixed plates steep, approaching perpendicular; movable valves flat, parallel to base; base of fixed plates thin, not

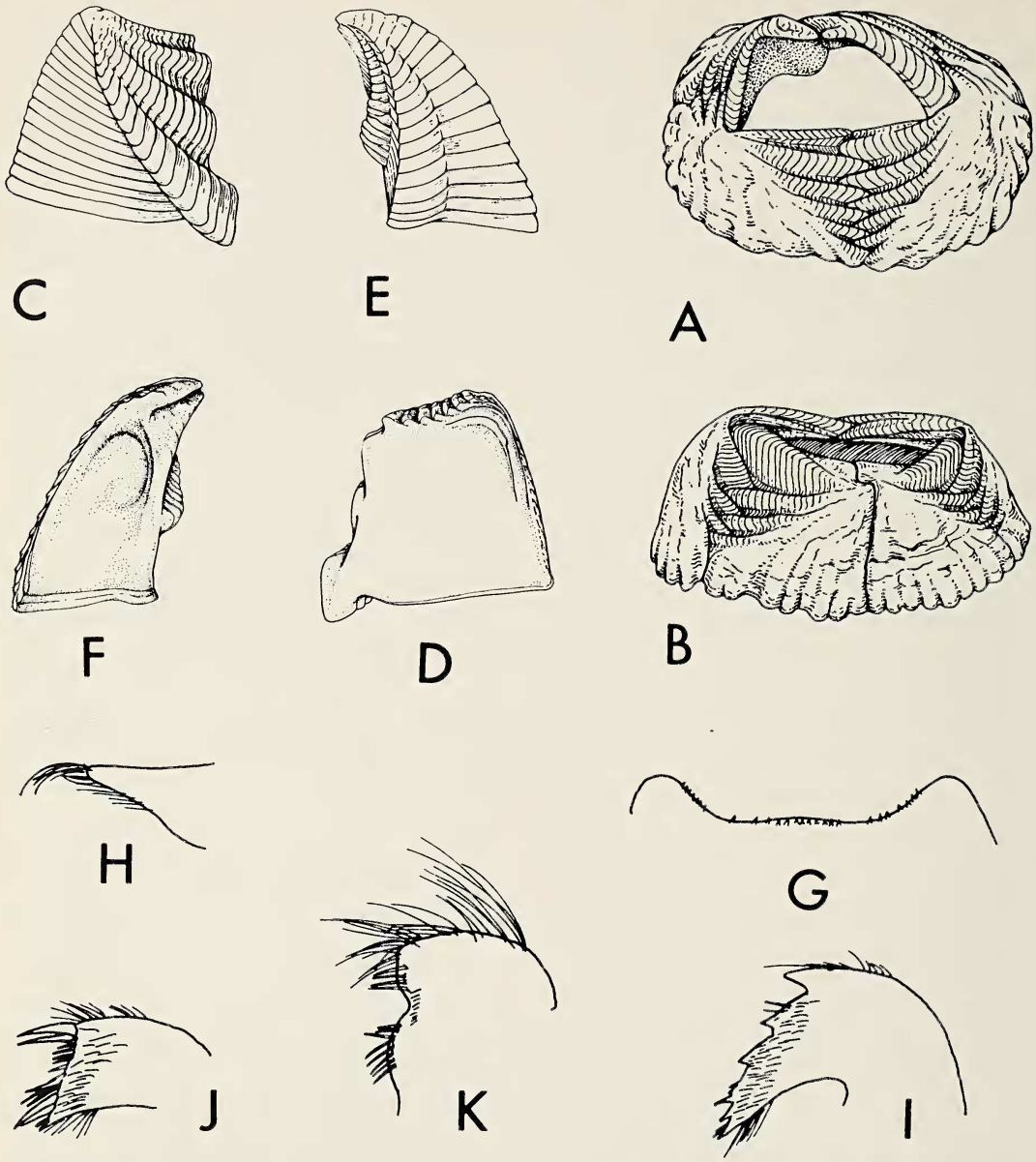


FIG. 4. *Verruca scrippsae* Zullo, sp. nov., holotype UCMP 34713. Figs. *A, B,* Sheli, × 10. Fig. *B,* Scutotergal view. Fig. *A,* Carinorostral view. Figs. *E, F,* Movable scutum, × 21. Figs. *C, D,* Movable tergum, × 21. Figs. *G–K,* Trophi, × 40. Fig. *G,* Labrum. Fig. *H,* Palpus. Fig *I,* Mandible. Fig. *J,* Inner maxilla. Fig. *K,* Outer maxilla.

inflected, regularly and coarsely denticulate; basal denticulae impressed into shell of gastropod to which attached, leaving circular scar upon removal.

Movable scutum (Figs. *4E, F*) with two articular ridges separated by narrow, shallow furrow; first ridge forming large tooth on otherwise unadorned tergal margin; second or crescentic ridge extending to basitergal angle; remainder of exterior of valve without ridges, ornamented only by deep, regularly spaced grooves separating growth increments; interior of movable scutum with large, distinct, kidney-shaped adductor pit in apical part of valve; upper and

tergal margins of adductor pit bounded by high ridge separating pit from deep, narrow articular furrow at apex.

Movable tergum (Figs. 4*C, D*) squared, but with carinal margin longer than occludent margin; three prominent articular ridges present; occludent margin bearing small, thin ridge not extending to apex; remainder of exterior without ridges, ornamented only by deep, narrow, closely spaced grooves separating growth increments; interior of movable tergum flat, smooth.

Carina (Fig. 4*A*) with four ridges terminating in articular teeth at rostral border; low, indistinct ridge borders tergal margin above uppermost articulating ridge; basal margin indistinctly lobed; lobes corresponding to basal denticulae.

Rostrum (Fig. 4*A*) with five ridges terminating in articular teeth at carinal border; apex at margin of plate; margin of uppermost ridge forming scutal margin; lowermost two ridges eroded and indistinct; basal margin deeply and irregularly lobed, corresponding to basal denticulae.

Articulation between fixed scutum and fixed tergum linear (Fig. 4*B*) obscured from exterior; fixed scutum (Figs. 4*A, B*) articulating with rostrum by means of three ridges interposed with four ridges on rostrum; main part of plates ornamented by low, indistinct, longitudinal ribs terminating in basal lobes; depressed triangular area bordering movable scutum ornamented by deep, sinuous, irregularly spaced, vertical grooves; interior of fixed scutum with indistinct adductor pit bordered below by thin, low, erect, concave adductor myophore or ridge.

Fixed tergum (Fig. 4*B*) with two ridges articulating with three ridges on carina; main part of plate ornamented by eroded, low, broad, longitudinal ribs terminating in regularly spaced lobes on basal margin; depressed triangular area bordering movable tergum ornamented as in fixed scutum; interior of tergum smooth.

Labrum (Fig. 4*G*) concave, bearing several minute, conical teeth on crest.

Palpus (Fig. 4*H*) elongate-triangular with apex at inner margin; row of short spines along superior margin, and tuft of longer, curved spines at apex on inner margin.

Mandible (Fig. 4*I*) with three teeth; uppermost tooth largest; cutting edge below third tooth, and inferior angle pectinate; single, large toothlike spine amid smaller spines above inferior angle.

Inner maxilla (Fig. 4*J*) without notch below upper two large spines; area between upper two large spines and large spines on lower half concave, bearing several short spines; lower part of cutting edge protrudent, bearing four larger spines followed by several small, slender spines at inferior angle.

Outer maxilla (Fig. 4*K*) notched in center of inner margin; inner margin on either side of notch bearing row of short spines; superior margin bearing numerous long, curved spines.

Cirrus I densely setose; posterior ramus about twice as long as anterior ramus; segments of anterior and posterior rami becoming long and slender terminally.

Cirrus II densely setose; posterior ramus about one-third again as long as anterior ramus; segments of anterior ramus somewhat protrudent; segments of posterior ramus becoming long and slender terminally.

Cirrus III more similar to cirri IV–VI than to cirri I and II; rami slender, subequal, with posterior ramus slightly longer and stouter; three to four pairs of spines per segment.

The number of segments on the cirri of holotype UCMP 34713 are as follows:

Cirrus:	I	II	III	IV	V	VI
anterior ramus:	11	8–9	17	18	22	27
posterior ramus:	15	13–16	21–22	24	24	26

Caudal appendage long, about 2½ times length of pedicel of cirrus VI, with 18 segments.

Penis not known.

TYPE DESIGNATION: A single specimen on shell of *Sipho* sp. with *Balanus nascanus* Zullo sp. nov., designated as holotype UCMP 34713.

DISCUSSION: *Verruca scrippsae* is assigned to the typical subgenus of *Verruca* on the basis of the indistinct, linear nature of the suture between fixed scutum and tergum, and the horizontal plane of the movable scutum and tergum. Pilsbry (1916) recognized four groups of species within the subgenus *Verruca* based on characteristics of the cirri, the caudal appendage, and the base of the shell wall. *Verruca scrippsae* cannot definitely be assigned to any one of these groups.

In the slender nature of the cirri, the moderately long caudal appendage, and the low ad-

ductor ridge, *V. scrippsae* resembles members of the *V. alba* group, but differs in the absence of riblets which terminate on the scutotergal margins of the scutum and carina. *Verruca scrippsae* also bears resemblance to members of the *V. calotheca* group, especially in the presence of large unribbed areas on the exterior of the movable scutum and tergum, and in the absence of short, curved ribs on the scutotergal margins of the rostrum and carina (i.e., *V. entobapta* Pilsbry and *V. macani* Stubbings). *Verruca scrippsae* is most easily distinguished from the *V. nexa* group by the vertical rather than inflected basal margin of the shell wall, and by the marginal rather than submarginal apex of the rostrum. The sharp basal edge of the shell wall, and the presence of well-defined articulating ribs between rostrum and fixed scutum and carina and fixed tergum in *V. scrippsae* suggest affinities with the shallow-water *V. stroemia* group. In these two features *V. scrippsae* differs from members of the "deep-water" groups.

SUBORDER BALANOMORPHA Pilsbry

FAMILY BALANIDAE Gray, emended

SUBFAMILY BALANINAE Gray, emended

GENUS *Balanus* Da Costa, 1778

SUBGENUS *Solidobalanus* Hoek, 1913

Solido-Balanus Hoek, 1913, *Siboga*-Expeditie, mon. 31b, p. 159.

Solidobalanus Hoek. Pilsbry, 1916, U.S. Nat. Mus. Bull. 93, p. 220.

Balanus* (*Solidobalanus*) *nascanus Zullo, sp. nov.

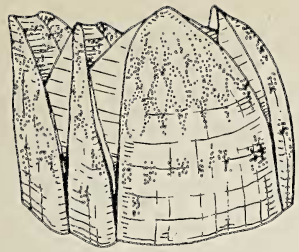
Figs. 5*A–K*

Dimensions of holotype UCMP 37855: height of shell, 2.5 mm; carinorostral diameter of base, 3 mm; greatest lateral diameter of shell, 2 mm; carinorostral diameter of orifice, 2 mm.

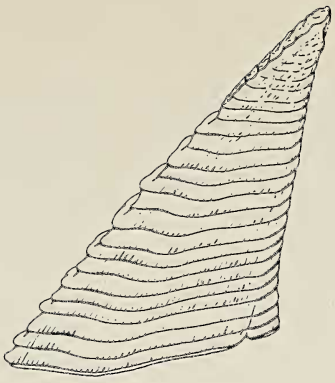
Shell high conic or cylindric; holotype UCMP 37855 (Fig. 5*A*) and paratype UCMP 37858 small, elongate along carinorostral axis, with deeply concave basis resulting from attachment on gorgonians; specimen on shell of *Sipho* sp. (UCMP paratype 37856) larger, up to 6 mm in height and basal diameter, with flat basis and nearly circular basal outline; dried specimens colored white or mottled orange; parieties smooth or longitudinally plicate; exterior of parieties and radii covered by adherent, buff-colored epidermis; orifice large, moderately toothed, diamond-shaped; radii thick, wide, with irregularly crenulated sutural edges; surface of radii glossy with distinct, regularly spaced, transverse striae; summits of radii oblique, about 30° from plane of orifice; alae thick with indistinctly crenulated sutural edges; summits of alae oblique, convex, projecting above radii; parieties solid, ribbed interiorly near the basis, the ribs fading about half-way to the sheath; base of parieties with sharp ribs for attachment to basis; sheath from one-fourth to one-half length of compartmental plate, without space beneath lower edge; basis solid, thickened on periphery; periphery furnished with denticulae for articulation with compartmental plates; inner surface of basis with distinct radial ribs.

Scutum (Figs. 5*B, C*) white, externally ornamented by shallow, regularly spaced grooves separating flat growth increments; alternate increments forming sharp, sinuous teeth on occludent margin; growth increments ornamented by indistinct, closely spaced, radial striae; occludent margin straight; tergal margin concave, reflexed almost 90°; basal margin sinuous, shorter than tergal margin; surface of scutum concave exteriorly; articular furrow broad, shallow, and finely denticulate; articular ridge long, four-fifths length of tergal margin, erect, and high, especially in lower half; no adductor ridge; pit for adductor muscle small, oval, shallow, situated near occludent margin; pit for lateral depressor muscle small, deep; lower fourth of occludent margin inflected, forming small pit in basioccludent angle.

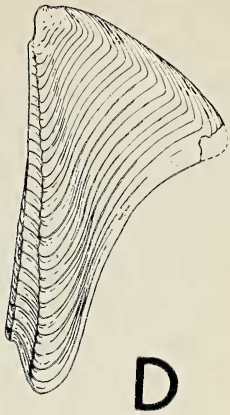
Tergum (Figs. 5*D, E*) narrow, almost twice as long as broad; color white; apex not produced; exterior ornamented by closely spaced growth lines which are finely striate on either side of spur fasciole; spur fasciole delimited by impressed grooves on either side; spur narrow, about as long as wide, terminating in rounded point; spur close to but distinct from basiscutal angle, and curving with only a slight break into the basal margin on the carinal side; scutal margin straight, reflected 90°, denticulate in some specimens; carinal margin convex, delimited by



A



B



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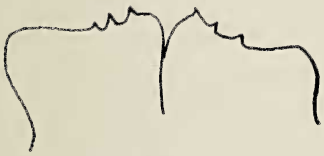

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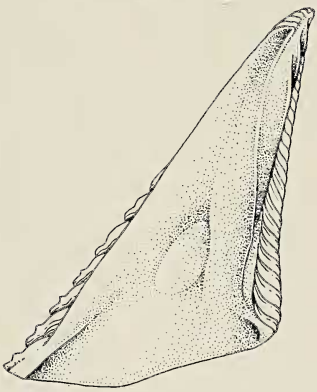

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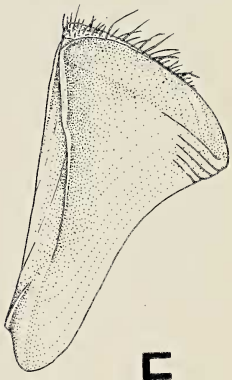

E

G

K

J

H

I

upturned growth lines; basal margin concave; articular furrow broad, shallow; articular ridge high, sharp, not overhanging furrow; crests for lateral depressor muscles well developed, short, usually three in adults.

Labrum (Fig. 5*F*) notched, with three sharp, prominent teeth on either side paratype UCMP 37857, and three on the left and two on the right side in holotype UCMP 37855; margin of labrum sinuous, a small, prominent convexity bordering on either side of notch, followed by a broad, shallow concavity in which teeth are primarily situated; concavity followed distally by broad, low convexity terminating at edge of labrum.

Palpi (Fig. 5*G*) with numerous, short, pectinate spines irregularly arranged along superior margins; three or four long, curved, pectinate spines situated on inner margin.

Mandibles (Figs. 5*H, I*) with five teeth including inferior angle, excepting one mandible of holotype UCMP 37855 with only four teeth, the second and third appearing fused; first tooth largest; second and third teeth approximately equal in size; third tooth bifid, terminating in point; fourth tooth smaller than preceding teeth, bifid, with one or two small, sharp accessory denticles above and below; inferior angle trispinose; uppermost spine of inferior angle broadest, lowermost spine longest; row of 10 or 11 long, slender spines on inferior margin; spines nearest inferior angle usually pectinate curved towards inferior angle; anterior and posterior surfaces of mandible densely spinose.

Inner maxillae (Fig. 5*J*) notched below uppermost two large spines; one or two small, slender spines in notch; four spines below notch followed by two large spines; large spines followed by two or three small spines on inferior angle; inferior margin bearing several small, slender spines.

Outer maxillae (Fig. 5*K*) oval, bearing a few long, slender, distantly spaced spines arranged in three parallel rows.

Rami of cirri I and II densely setose, unequal, with outer rami longer; segments slightly protrudent.

Rami of cirrus III similar in structure to those of cirri I and II, excepting in fewer number of spines on segments.

Cirri IV–VI longer than preceding cirri, with four to five pairs of spines per segment; short hairs present at base of spines.

The number of segments on cirri I–III of the right side of paratype UCMP 37857 is as follows:

Cirrus:	I	II	III
outer ramus:	6	8	9
inner ramus:	5	7	9

Penis long, with small tufts of spines scattered sparingly over surface; tufts common on annulations near extremity of penis; extremity blunt, covered with thick tuft of long spines; no basidorsal point seen.

TYPE DESIGNATION: Four specimens on gorgonians, holotype UCMP 37855, paratypes UCMP 37857; one on shell of *Sipho* sp. with *Verruca scrippsae* Zullo, sp. nov., paratype UCMP 37856.

DISCUSSION: Thirteen species of the subgenus *Solidobalanus* have previously been described from the Western Pacific, eastern Atlantic, and Indian oceans. They are:

Balanus (*Solidobalanus*) *astacophilus* Barnard (1925:128); Mozambique coast.

Balanus (*Solidobalanus*) *auricoma* Hoek (1913:199, pl. 18, figs. 20–22; pl. 19, figs. 1–7); Moluccan Straits (Hoek, 1913; Broch, 1931); southeast Australian coast (Broch, 1922); Persian Gulf (Nilsson-Cantell, 1938).

Balanus (*Solidobalanus*) *ciliatus* Hoek (1913: 199, figs. 8–16); Flores Sea (Hoek, 1913); Sulu Archipelago (Broch, 1931); Siam Bay (Nilsson-Cantell, 1934*a*); Strait of Malacca, Indian Ocean (Nilsson-Cantell, 1934*b*); Andaman Sea, east coast of India, Ceylon, Gulf of Manaar, Arabian Sea, Persian Gulf (Nilsson-Cantell, 1938); Gulf of Aden, Red Sea (Stubbings, 1936).

Synonym: *Balanus maldivensis* Borradaile,

FIG. 5. *Balanus nascanus* Zullo, sp. nov. Fig. *A*, Shell of holotype UCMP 37855, × 10. Figs. *B–D*, Opercular valves of paratype UCMP 37856, × 5. Figs. *B, C*, Scuta. Fig. *D*, Tergum. Fig. *E*, Tergum of holotype UCMP 37855, × 20. Figs. *F, K*, Trophi of paratype UCMP 37857, × 45. Figs. *G–J*, Trophi of holotype UCMP 37855, × 45. Fig. *F*, Labrum. Fig. *G*, Palpus. Fig. *H*, Mandible. Fig. *I*, Aberrant mandible. Fig. *J*, Inner maxilla. Fig. *K*, Outer maxilla.

of Annandale (1906*a*, p. 148) from the Gulf of Manaar (Nilsson-Cantell, 1938:50).

Balanus (*Solidobalanus*) *compressus* Hoek (1913:202, pl. 19, fig. 17; pl. 20, figs. 1–7); Banda Sea, Timor Sea.

Balanus (*Solidobalanus*) *echinoplacis* Stubbings (1936:45, figs. 20a–k); Zanzibar area.

Balanus (*Solidobalanus*) *hawaiensis* Pilsbry (1916:222, pl. 48, figs. 1–1g; text figs. 70a–c); Hawaiian Islands.

Balanus (*Solidobalanus*) *maldivensis* Borradaile (1903:442, fig. 118); Maldive Islands.

Balanus (*Solidobalanus*) *occidentalis* Stubbings (1961:34, text figs. 8–11); tropical West Africa.

Balanus (*Solidobalanus*) *pseudauricoma* Broch (1931:72, figs. 25a–i); Molucca Sea, Japan.

Balanus (*Solidobalanus*) *socialis* Hoek (1883: 150, pl. 13, figs. 23–28); Arafura Sea (Hoek, 1883); Moluccas, Flores Sea (Hoek, 1913); Java Sea (Nilsson-Cantell, 1934*a*); British North Borneo (Nilsson-Cantell, 1937); Gulf of Manaar, Ceylon (Nilsson-Cantell, 1938); Japan (Utinomi, 1949). *Synonyms: Balanus aeneas* Lanchester (1902:370) and *B. aeneas* Lanchester of Annandale (1906*a*:148) from the Malay Peninsula and the Gulf of Manaar, respectively (Pilsbry, 1916; Nilsson-Cantell, 1938).

Balanus (*Solidobalanus*) *solidus* Broch (1931: 76, figs. 26a–i); Japan.

Balanus (*Solidobalanus*) *tantillus* Pilsbry (1916:224, pl. 48, figs. 2–2e; text figs. 72a–c); Sulu Archipelago.

Balanus (*Solidobalanus*) *thompsoni* Stubbings (1936:43, figs. 19a–h); Gulf of Aden.

Balanus nascanus resembles *B. hawaiensis* Pilsbry from the Hawaiian Islands. However, there are certain characters which distinguish the new species. The articular ridge of the scutum of *B. nascanus* is erect, whereas Pilsbry (1916:222) describes that of *B. hawaiensis* as "somewhat reflexed." Pilsbry did not describe the pit for the lateral depressor muscle, but that of the figured scutum (Pilsbry, 1916, pl. 48, fig. 1f) is only vaguely indicated, whereas the lateral depressor pit of *B. nascanus* is deep and prominent. The exterior of the scutum of the new species is ornamented by fine, closely spaced, radial striae which are not present in *B. hawaiensis*. The tergum of *B. nascanus* is narrower than that of *B. hawaiensis*. In addition Pilsbry (1916:222) describes the tergal spur of *B. hawaiensis* as "very short, tapering to a rounded end." Measurements of his figures indicate that the length of the spur is approximately equal to one-half the width of the spur at the basal margin. The spur of *B. nascanus* is longer (its length being nearly equal to the spur width), more pointed distally, and placed closer to the basiscutal angle. The margin of the labrum of *B. nascanus* differs in being sinuous rather than straight, and the mandible differs in having a pointed, bifid third tooth on the cutting edge and accessory teeth above and below the fourth tooth as in *B. tantillus* (Pilsbry, 1916, text fig. 72c).

Balanus nascanus can be distinguished from *B. ciliatus, B. compressus,* and *B. socialis* by the the absence of teeth or hooks on cirri III and IV. *Balanus astacophilus* can be separated by the shorter, broader tergal spur, and by the greater number of teeth both on the mandibles and on the labrum. In *B. auricoma* the tergal spur is more distantly removed from the tergal margin and the mandible does not possess the distinctive trispinose inferior angle of *B. nascanus* and *B. hawaiensis. Balanus echinoplacis, B. pseudauricoma, B. solidus,* and *B. thompsoni* also lack the trispinose inferior angle on the mandible, and can further be distinguished by their possession of a short, broad, obliquely truncate tergal spur. In addition; *B. echinoplacis* is described as having a porous basis, whereas that of *B. nascanus* is solid.

Balanus maldivensis and *B. tantillus* are similar to *B. nascanus* in the form of the opercular valves. *Balanus maldivensis,* however, can be distinguished by the horizontal summits of the radii and the form of the mandible, and *B. tantillus* differs in having the tergal spur confluent with the basiscutal angle. The recently described West African species *B. occidentalis* resembles *B. nascanus* in the characters of the trophi, but differs in the possession of teeth on the anterior border of the posterior ramus of cirrus III, in the lack of radial striae on the exterior of the scutum, and in the broader tergal spur placed farther from the basiscutal angle.

Species of the subgenus *Solidobalanus,* being for the most part restricted to subtidal depths, are known by relatively few individuals, and as a result little information is available concerning the range of variation of the characters which are presently considered significant at the specific level. Future collections, especially from the Pacific, may indicate that the characters used in separating such geographically widespread, morphically similar species as *Balanus auricoma, B. hawaiensis,* and *B. nascanus* are variable, and that these three species, and perhaps others, may be merged into a single species. At the present time, however, it would appear more prudent to differentiate the eastern Pacific solidobalanid by establishing a new species.

SUMMARY

Representatives of four new species of thoracic cirripedes were obtained in a dredge haul at 228 m depth on a guyot on the southwest end of Nasca Ridge about 1280 km off the coast of Chile.

1) *Megalasma elegans* Newman, sp. nov., is related to *M. striatum* Hoek, but differs in the absence of the beaded ridge extending from below the scutal umbones across the scuta and carina to the carinal umbones; in the form of the trophi; and in the presence of pinnate setae on the cirri and plumose spines on the caudal appendage.
2) *Heteralepas mystacophora* Newman, sp. nov., is remarkable for the presence of numerous soft setae clothing the bullate portion of the labrum.
3) *Verruca scrippsae* Zullo, sp. nov., resembles members of the shallow-water *V. stroemia* group in the sharpness of the basal edge of the shell wall and the presence of well-developed articulating ridges between rostrum and fixed scutum and carina and fixed tergum, but differs in the more slender cirri, longer caudal appendage, and low adductor ridge.
4) *Balanus* (*Solidobalanus*) *nascanus* Zullo, sp. nov., is related to *B. hawaiensis* Pilsbry, but can be distinguished by the narrower tergum with a longer tergal spur, and by the presence of radial striae on the scutal exterior.

Megalasma, Solidobalanus, and the "deep-water" verrucids have not been reported previously from the eastern Pacific.

REFERENCES

ANNANDALE, N. 1905. Malaysian barnacles in the Indian Museum, with a list of the Indian Pedunculata. Mem. Asiatic Soc. Bengal 1(5): 73–84, text figs. 1–3, pl. 8.

——— 1906*a*. Report on the Cirripedia collected by Professor Herdman, at Ceylon, in 1902. Rept. Govt. Ceylon on Pearl Oyster Fisheries of Gulf of Manaar, 5 Suppl. Repts. 31:137–150, text figs. 1–9.

——— 1906*b*. Natural history notes from the R.I.M.S. Ship "Investigator," Series III, No. 12. Preliminary report on the Indian stalked barnacles. Ann. Mag. Nat. Hist. (7)17:389–400.

——— 1907–1908. Illustrations of the Zoology of the R.I.M.S. Ship "Investigator." Crustacea Entomostraca. 1907: Pt. 1, pls. 1–2. 1908: Pt. 2, pls. 3–4.

——— 1909. An account of the Indian Cirripedia Pedunculata, Pt. I. Family Lepadidae (s. str.). Mem. Indian Mus. 2(2):51–137, text figs. 1–11, pls. 6–7.

AURIVILLIUS, C. W. S. 1894. Studien über Cirripedien. Kongl. Svenska Vetensk.-Akad. Handl. (4)26(7):1–107, pls. 1–9.

BARNARD, K. H. 1924. Contribution to the crustacean fauna of South Africa, no. 7. Cirripedia. Ann. S. Afr. Mus. 20(1):1–103, pl. 1.

——— 1925. Report on a collection of Crustacea from Portuguese East Africa. Trans. Roy. Soc. S. Afr. 13:119–129, 2 pls.

BORRADAILE, L. A. 1903. The barnacles (Cirripedia). In: The fauna and geography of the Maldive and Laccadive Archipelagos, edited by Gardiner, 1:440–443.

BROCH, HJ. 1922. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16, X. Studies on Pacific Cirripeds. Vidensk. Meddel. fra Dansk naturhist. Foren. København 73:215–358, text figs. 1–77.

——— 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16, LVI. Indoma-

layan Cirripedia. Vidensk. Meddel. fra Dansk naturhist. Foren. København 91:1–146, text figs. 1–41.

CALMAN, W. T. 1918. The type-specimens of *Poecilasma carinatum* Hoek (Cirripedia). Ann. Mag. Nat. Hist. (9)1:401–408, text figs. 1–3.

——— 1919. On barnacles of the genus *Megalasma* from deep-sea telegraph cables. Ann. Mag. Nat. Hist. (9)4:361–374, text figs. 1–7.

DARWIN, C. 1854. A monograph on the subclass Cirripedia, Balanidae, Verrucidae. Ray Society, London:1–684, pls. 1–30, text figs. 1–11.

FISHER, R. L. 1958. Preliminary report on Expedition DOWNWIND, University of California, Scripps Institution of Oceanography, IGY cruise to the southeast Pacific. IGY World Data Center A, Nat. Acad. Sci., IGY General Rept. Ser. 2:1–58.

GRUVEL, A. 1902. Sur quelques Lepádides nouveau de la collection du British Museum. Trans. Linn. Soc. London (8)8:277–295, text figs. 1–5, pl. 24.

——— 1905. Monographie des Cirrhipèdes ou Thécostracés. Paris: i-xii, 1–472, text figs. 1–427.

HOEK, P. P. C. 1883. Report on the Cirripedia collected by H.M.S. "Challenger" during the years 1873–1876. Rept. Scient. Res. "Challenger," 1873–1876, Zoology 8(25):1–169, pls. 1–13.

——— 1907. The Cirripedia of the *Siboga* Expedition, Pedunculata. *Siboga*-Expeditie, 31a: 1–127, pls. 1–10.

——— 1913. The Cirripedia of the *Siboga*-Expedition, B. Cirripedia sessilia. *Siboga*-Expeditie, 31b:i–xxv, 129–275, pls. 11–27, text figs. 1–2.

KRÜGER, P. 1940. Cirripedia. Bronns Klassen und Ordnungen des Tierreichs. Leipzig 5:1: 3:(3):1–560, text figs. 1–391, tables 1–35.

LANCHESTER, W. F. 1902. On the Crustacea collected during the "Skeat" Expedition to the Malay Peninsula, Pt. II. Anomura, Cirripedia and Isopoda. Proc. Zool. Soc. London, 1902, 2:363–381, pls. 34–35.

MACNEIL, F. S., J. B. MERTIE, JR., and H. A. PILSBRY. 1943. Marine invertebrate faunas of the buried beaches near Nome, Alaska. Jour. Paleont. 17:69–96, pls. 10–16.

NEWMAN, W. A. 1960. Five pedunculate cirripeds from the Western Pacific, including two new forms. Crustaceana 1(2):100–116, text figs. 1–6.

NILSSON-CANTELL, C. A. 1921. Cirripeden-Studien. Zool. Bidrag Uppsala, Bd. 7:75–395, text figs. 1–89, pls. 1–3.

——— 1927. Some barnacles in the British Museum (Nat. Hist.). Proc. Zool. Soc. London, 1927, (3):743–790, text figs. 1–19, pl. 1.

——— 1934*a*. Indomalayan cirripeds in the Raffles Museum, Singapore. Bull. Raffles Mus. 9:42–73, pl. 5, text figs. 1–7.

——— 1934*b*. Cirripeds from the Malay Archipelago in the Zoological Museum of Amsterdam. Zool. Meded., Rijksmus. natuur. hist., Leiden 17(1–2):31–63, text figs. 1–12.

——— 1938. Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. Mem. Indian Mus. 13(1):1–81, pls. 1–3, text figs. 1–28.

——— 1957. Reports on the Lund University Chile Expedition 1948–1949, 31. Thoracic cirripeds from Chile. Acta Univ. Lund (2) 53(9):1–25.

PILSBRY, H. A. 1907*a*. The barnacles (Cirripedia) contained in the collections of the U.S. National Museum. U.S. Nat. Mus. Bull. 60: 1–122, text figs. 1–36, pls. 1–11.

——— 1907*b*. Hawaiian Cirripedia. Bull. U.S. Bur. Fisheries 26:181–190, text figs. 1–4, pls. 4–5.

——— 1907*c*. Notes on the cirripede genus *Megalasma*. Proc. Acad. Nat. Sci. Phila. 59: 408–416, text figs. 1–6, pl. 31.

——— 1916. The sessile barnacles (Cirripedia) contained in the collections of the U.S. National Museum; including a monograph of the American species. U.S. Nat. Mus. Bull. 93:i–xi, 1–366, pls. 1–76, text figs. 1–99.

STUBBINGS, H. G. 1936. Cirripedia. Brit. Mus. (Nat. Hist.), John Murray Exped. 1933–1934, Scient. Rept. 4(1):1–70, text figs. 1–30.

——— 1961. Cirripedia Thoracica from tropical West Africa. Atlantide Rept. no. 6, Scient. Res. Danish Exped. coasts Trop. West. Afr. 1945–1946:7–41, text figs. 1–11.

UTINOMI, H. 1949. Studies on the cirripedian fauna of Japan VI. Cirripeds from Kyusyu and Ryukyu Islands. Publ. Seto Mar. Biol. Lab. 1(2):19–37, text figs. 1–6.

——— 1958. Studies on the cirripedian fauna of Japan, VII. Cirripeds from Sagami Bay. Publ. Seto Mar. Biol. Lab. 6(3):281–311, text figs. 1–10.

WELTNER, W. 1894. Zwei neue Cirripedien aus dem Indischen Ocean. Sitz.-Bericht Gesellsch. naturf. Freunde Berlin, Jahr. 1894, (2):80–87, text figs. 1–6.

——— 1922. Cirripedia der Deutschen Tiefsee-Expedition. Wiss. Ergebnisse der Deutschen Tiefsee-Exped. 23(2):59–112, text figs. 1–3, pls. 2–4.